

PETITION

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Your Petitioners, Ghassem Zarbi and Rory Bjarnason, citizens of Canada and residents of the Province of British Columbia, whose residence and mailing address for Ghassem Zarbi is 30585 Progressive Way, Abbotsford, British Columbia, Canada V2T 6W3 and for Rory Bjarnason is 30585 Progressive Way, Abbotsford, British Columbia, Canada V2T 6W3, pray that Letters Patent Protection be granted to them for an

IMPROVED COOLING FAN MECHANISM FOR

A MOTOR-DRIVEN PRESSURE WASHER

as set forth in the following specification:

Background of the Invention

1. Technical Field

The present invention is directed to pressure washers and, more particularly, to an improved cooling fan mechanism for a motor-driven pressure washer which includes a generally toroidal drive pulley rotatably mounted within the pressure washer which is driven by an engine within the pressure washer, the drive pulley including a generally cylindrical outer rim having outer and inner sides, a central hub and a plurality of spokes extending between the central hub and the outer rim for supporting the outer rim in spaced relation from the central hub with at least some of the plurality of spokes of the drive pulley each consisting of an angled, generally planar fan blade having a forward air-engaging edge generally adjacent the outer side of the outer rim and a

1 rearward edge generally adjacent the inner side of the outer rim,
2 the forward air-engaging edges of the fan blades operative to
3 engage air upon rotation of the drive pulley and force air into the
4 pressure washer via the fan blades to cool the interior of the
5 pressure washer thereby reducing the internal temperature of the
6 elements of the pressure washer.

8 **2. Description of the Prior Art**

9 Pressure washers are incredibly versatile and effective
10 cleaning tools. They can be used for vehicle cleaning, removing
11 stains, moss and mildew from brickwork, driveways, paths, patios
12 and even garden furniture. With the right attachment they can even
13 be used for cleaning and unblocking drains.

14 Pressure washers generate a high-speed, focused jet of water
15 by using a powerful motor to pump water (usually fed from a garden
16 hose) to very high pressures. This produces a high speed, highly
17 penetrating jet of water that is directed by a long handled lance
18 at the object to be cleaned. Pressure washers are also extremely
19 efficient and use as little as 1/10 the volume of water used by an
20 ordinary garden hose.

21 Pressure washers fall into two main categories:

22 i. Cold water pressure washers take water fed directly from
23 the cold water main supply and pump it out at high pressures (70 -
24 270 bar or 1000 to 4000 psi). On better quality machines, a siphon
25 tube or reservoir permits the addition of special detergents to aid
26 cleaning. There is a mechanism attached to this siphon tube that
27 prevents back flow and city water contamination. Cold water
28 pressure washers are excellent at removing organic matter, mud,

1 dirt and all water-soluble compounds. They will also remove fats,
2 oils and greases but work much better if degreasing compounds are
3 worked into these non-soluble compounds first.

4 ii. Hot water pressure washers work in the same way as their
5 cold water counterparts but heat the water up (before pumping) to
6 100°C - 140°C in an internal boiler. Hot water pressure washers
7 can be modified to be used as steam cleaners. Steam cleaners
8 require an electricity supply and a liquid fuel such as heating oil
9 or paraffin to heat the boiler.

10 Hot water pressure washers are excellent at removing very
11 heavy deposits of oils and greases from the objects being cleaned
12 and tend to leave a drier surface afterwards. Hot water pressure
13 washers are also especially useful for stripping off old, hardened
14 underseal. Because they can strip away non-soluble compounds
15 without the need for a degreasing solution, they should only be
16 used where the waste run-off passes through a special oil/water
17 separator. Hot water pressure washers are considerably more
18 expensive than cold-water cleaners.

19 The two conventional predominant pressure washer systems in
20 use today are belt-drive and electric pressure washers. They rely
21 on an engine to run the system and a water pump to pump the water
22 at very high pressures. The direct-drive is for applications not
23 requiring more than 30 hours of use per week. The pump is directly
24 coupled to the engine or motor causing the pump to spin twice as
25 fast as the belt drive models.

26 The belt-drive is most commonly found on industrial models and
27 is ideal for cleaning applications requiring 40+ hours of use per
28 week. The belt connecting the engine to the high-pressure pump

1 generates heat due to the high friction between the pulleys and
2 belt. The generated temperature rises to a temperature close to,
3 or even sometimes higher than the limit of the belt and causes the
4 thermal expansion of the belt material thus promoting the
5 development of belt shredding and slip problems. The heat is also
6 transferred to pump and other key components through conduction,
7 which results in an additional rise in their operational
8 temperature. There is therefore a need for an improved cooling
9 fan mechanism which will decrease the operational temperature of
10 the components of the pressure washer thereby enhancing the cycling
11 life of belts, pump and other key components of the belt-drive
12 unit.

13 Without sufficient system airflow, many of today's pressure
14 washer systems would overheat. Air can flow passively through
15 system (this is the least expensive and most reliable form of
16 cooling) or it can be driven through the system by a fan or blower.
17 When a fan is required, system requirements will drive the
18 selection of the right fan for the application, such as system
19 pressure drop, acoustic restrictions, reliability requirements, and
20 product mobility. Each of these may play a role in the choice of
21 the fan system.

22 Fans can be thought of as low-pressure air pumps that utilize
23 power from a motor to output a volumetric flow of air at a given
24 pressure. A propeller converts torque from the motor to increase
25 static pressure across the fan rotor and to increase the kinetic
26 energy of the air particles. Each fan has only one design point,
27 which is established by a specific airflow, total pressure, air
28 density, and fan speed. Starting with these data, it is possible

1 to determine one platform and the twist distribution, which will
2 accomplish the required work with minimum horsepower.

3 To move air, the fan must overcome two resistances, which are
4 measured as pressure drops across the fan. The first is a
5 parasitic loss called the velocity pressure loss, which is the
6 energy required to move the required air quantity without doing any
7 work to overcome the system resistance. However, work is being
8 done to move the hot air away from the equipment. The second
9 resistance is the static pressure loss, which is the accumulated
10 loss due to inlet louver, fill, drift eliminator, and fan inlet
11 pressure drop, etc. This represents the work to be accomplished
12 and reflects the design of the total system. Whether the air is
13 distributed evenly across the fan is primarily a function of the
14 blade and hub design. A properly designed blade will have adequate
15 chord width and twist to ensure an even distribution of velocity
16 pressure over its entire length. A properly designed hub will
17 include a center air-seal disk, which prevents negative airflow
18 into the center of the fan.

19 The selection procedure for the fan requires an optimum fan
20 diameter, number and type of blades, required pitch angle, fan rpm,
21 and some estimate of horsepower. In some cases, an estimated
22 sound-pressure level is essential to satisfy Environmental
23 Protection Agency (EPA) requirements for working area noise levels,
24 more importantly noise level at a plant boundary, or a given noise
25 sensitive location such as a residential area.

26 The factors that must be known when installing or replacing a
27 fan on an existing installation are:

- 28 • Fan diameter.

1 Installed engine horsepower.

2 • Gear reduction ratio of gear reducer.

3 Shaft size or gear reducer model.

4 • Some estimate of elevation above sea level of installation.

5 However, it is not always expedient to undertake such a
6 detailed review of the replacement or installation needs for a
7 cooling fan for the pressure washer, particularly in light of the
8 relatively inexpensive nature of many pressure washers. It is far
9 more preferable, then, that the pressure washer include an integral
10 cooling fan mechanism, one which does not require the user of the
11 pressure washer to perform significant additional functional
12 determinations to allow proper operation of the cooling fan
13 mechanism.

14 Therefore, an object of the present invention is to provide an
15 improved cooling fan mechanism for motor-driven pressure washers.

16 Another object of the present invention is to provide an
17 improved cooling fan mechanism for motor-driven pressure washers
18 which includes a drive pulley mounted on the engine which includes
19 at least one generally planar fan blade replacing at least one of
20 the spokes of the drive pulley for directing air into the interior
21 of the pressure washer as the drive pulley is rotated.

22 Another object of the present invention is to provide an
23 improved cooling fan mechanism for motor-driven pressure washers
24 which includes a generally toroidal drive pulley rotatably mounted
25 within the pressure washer which is driven by an engine within the
26 pressure washer, the drive pulley including a generally cylindrical
27 outer rim having outer and inner sides, a central hub and a
28 plurality of spokes extending between the central hub and the outer

1 rim for supporting the outer rim in spaced relation from the
2 central hub with at least some of the plurality of spokes of the
3 drive pulley each consisting of an angled, generally planar fan
4 blade having a forward air-engaging edge generally adjacent the
5 outer side of the outer rim and a rearward edge generally adjacent
6 the inner side of the outer rim, the forward air-engaging edges of
7 the fan blades operative to engage air upon rotation of the drive
8 pulley and force air into the pressure washer via the fan blades to
9 cool the interior of the pressure washer thereby reducing the
10 internal temperature of the elements of the pressure washer.

11 Another object of the present invention is to provide an
12 improved cooling fan mechanism for motor-driven pressure washers
13 which generally eliminates the need for additional cooling fan
14 units to be used with the pressure washer.

15 Another object of the present invention is to provide an
16 improved cooling fan mechanism for motor-driven pressure washers
17 which provides a cooling air flow for the majority of the
18 operational elements of the pressure washer and will provide
19 additional volume of air movement as the rotational speed of the
20 engine is increased.

21 Another object of the present invention is to provide an
22 improved cooling fan mechanism for motor-driven pressure washers
23 which is usable with many different types of pressure washers, and
24 is not proprietary to any one specific unit.

25 Finally, an object of the present invention is to provide an
26 improved cooling fan mechanism for motor-driven pressure washers
27 which is relatively simple and durable in construction and is safe
28 and efficient in use.

1 **Summary of the Invention**

2 The present invention provides an improved cooling fan
3 mechanism for a motor-driven pressure washer which includes a
4 generally toroidal drive pulley rotatably mounted within the
5 pressure washer which is driven by an engine within the pressure
6 washer, the drive pulley including a generally cylindrical outer
7 rim having outer and inner sides, a central hub and a plurality of
8 spokes extending between the central hub and the outer rim for
9 supporting the outer rim in spaced relation from the central hub
10 with at least some of the plurality of spokes of the drive pulley
11 each consisting of an angled, generally planar fan blade having a
12 forward air-engaging edge generally adjacent the outer side of the
13 outer rim and a rearward edge generally adjacent the inner side of
14 the outer rim, the forward air-engaging edges of the fan blades
15 operative to engage air upon rotation of the drive pulley and force
16 air into the pressure washer via the fan blades to cool the
17 interior of the pressure washer thereby reducing the internal
18 temperature of the elements of the pressure washer.

19 Prior to undertaking the preliminary and conceptual design of
20 the present invention, a market survey was conducted through
21 Internet searching, patent and literature searching, and by
22 contacting various manufacturers. The combination of fan-pulley
23 and belt-drive system in a pressure washer unit has not been
24 attempted in the past as the market survey showed. There is a
25 particular potential demand for the design that could offer
26 temperature reduction and lifetime extension in each component.
27 With existing conventional belt-drive pressure washer systems, the
28 temperature of each component increases as the device operates, and

1 this component heating reduces the lifetime and efficiency of the
2 device.

3 The cooling fan mechanism for motor-driven pressure washers as
4 thus described provides several advantages not found in the prior
5 art. For example, because it is the drive pulley which
6 incorporates the fan elements of the present invention, additional
7 drive mechanisms for a separate fan blade unit are rendered
8 unnecessary. Also, the positioning of the fan blades within the
9 drive pulley permits the airflow directed by the rotation of the
10 fan blades to immediately access and cool the internal functional
11 elements of the pressure washer, and an external fan unit would not
12 be able to access the same area for cooling without interfering
13 with the safety and operation of the pressure washer operational
14 elements. Furthermore, the elimination of external fan units will
15 greatly reduce the risk of injury from contact with the rotating
16 fan blades, as the fan blades of the drive pulley are protected
17 within the housing. Finally, because the cooling fan mechanism for
18 motor-driven pressure washers of the present invention is capable
19 of being retrofitted onto existing pressure washer units, the
20 unique benefits of the invention can be added to many already
21 manufactured units. It is thus seen that the cooling fan mechanism
22 for motor-driven pressure washers of the present invention provides
23 a substantial improvement over those devices found in the prior
24 art.

1 **Brief Description of the Drawings**

2 Figure 1 is a perspective view of the motor-driven pressure
3 washer with the improved cooling fan mechanism of the present
4 invention fitted thereon;

5 Figure 2 is a front elevational view of the cooling fan
6 mechanism of the present invention showing the modified drive
7 pulley;

8 Figure 3 is a perspective view of the modified drive pulley of
9 the present invention;

10 Figure 4 is a detailed exploded perspective view of the motor-
11 driven pressure washer of the present invention showing the various
12 elements thereof;

13 Figure 5 is a rear side elevational view of the internal
14 features of the motor-driven pressure washer; and

15 Figure 6 is an end elevational detailed view of the motor-
16 driven pressure washer and cooling fan mechanism of the present
17 invention showing air being drawn into the unit and distributed to
18 the internal operating elements of the motor-driven pressure
19 washer.

Description of the Preferred Embodiment

The improved cooling fan mechanism **10** of the present invention is best shown in Figures **1-4** as being mounted on a motor-driven pressure washer **80** for improved cooling of the engine, pump and belts of the motor-driven pressure washer **80**. Before beginning the discussion of the improved cooling fan mechanism **10**, a brief description of the general features of the motor-driven pressure washer **80** is needed in order to understand the functional characteristics of the improved cooling fan mechanism **10**. As shown best in Figures **1** and **4**, the motor-driven pressure washer **80** would include a base platform **82** having wheels **84a** and **84b** and a forward ground-engaging stand **86** mounted on the underside of the base platform **82**. A handle **88** would project upwards from the base platform **82** for moving the motor-driven pressure washer **80**. A gasoline or electric-powered engine **90** is mounted on the base platform **82**, the engine **90** including a power output shaft **92** which is rotated by the engine **90**. Also mounted on base platform **82** rearwards of engine **90** is a water pump **94** which is connected to the power output shaft **92** of engine **90** via a drive belt **96** or the like. If the output speed of the power output shaft **92** of engine **90** is generally constant, the relative speed of rotation of water pump **94** is controlled by the relative size of drive pulley **12** mounted on power output shaft **92** of engine **90** and water pump drive pulley **98** mounted on the drive shaft **95** of water pump **94**. Finally, the entire drive belt mechanism is enclosed within a safety housing **100**, as shown best in Figures **1** and **4**.

To this point, the motor-driven pressure washer **80** of the present invention is of a generally standard type, and would

1 further include a hookup hose (not shown) to connect the water pump
2 **94** to a water source, a high-pressure hose **102** connected to the
3 outflow of the water pump **94** and a trigger-controlled gun with a
4 flow-through wand handle **104** connected to the high-pressure hose
5 **102** which is used in the standard pressure washer manner. However,
6 the present invention provides a significant improvement over those
7 pressure washer devices found in the prior art, in that the motor
8 drive pulley **12** includes modifications which enable the motor drive
9 pulley **12** to not only drive the water pump **94**, but also provide
10 cooling for the motor-driven pressure washer **80** of the present
11 invention.

12 Specifically, the motor drive pulley **12** would include a
13 plurality of fan blades **14** which replace the standard spokes
14 extending between the center axle hub **16** and generally cylindrical
15 outer rim **18** of the motor drive pulley **12**. In the preferred
16 embodiment, the motor drive pulley **12** would have a diameter of
17 approximately six to twelve inches (6" to 12") and would be
18 constructed of a rigid material such as cast iron, aluminum or
19 other such high-strength metal. As each of these fan blades **14** are
20 preferably constructed in a similar manner, the following
21 description of one of the fan blades **14** should be understood to
22 apply equally to each of the fan blades **14**. Fan blade **14** is
23 preferably constructed as including a generally flat air deflection
24 plate **18**, having a forward air-engaging edge **30** generally adjacent
25 outer edge **20** of outer rim **18** and a rearward edge **32** generally
26 adjacent inner edge **22** of outer rim **18**, as shown best in Figure 3.
27 It is further preferred that the air deflection plate **28** be angled
28 at an angle of approximately ten to forty-five degrees (10° to 45°)

1 from perpendicular to the center axis of the motor drive pulley 12
2 as per a standard fan blade to deflect air encountered during the
3 rotation of the fan blade 14 towards the inner edge 22 of outer rim
4 18 and inwards to the internal elements of the motor-driven
5 pressure washer 80, including the engine 90 and water pump 94.
6 Also, it should be noted that the precise size and shape of the air
7 deflection plate 28 is not critical to the present invention so
8 long as the air encountering the air deflection plate 28 is
9 deflected inwards towards and past inner edge 22 of outer rim 18 as
10 described above. In fact, it is expected that slight concave
11 curvature of the air deflection plate 28 of fan blade 14 may be
12 desirable in order to provide additional air propulsion towards the
13 internal elements of the motor-driven pressure washer 80. Also,
14 the number of fan blades 14 is not critical to the present
15 invention so long as at least one of the spokes 13 of motor drive
16 pulley 12 are constructed as fan blades 14 to deflect and drive air
17 for cooling purposes into the interior of the motor-driven pressure
18 washer 80.

19 Another important feature of the present invention is the
20 inclusion of louvers 50 positioned in the sidewall of drive belt
21 housing 100 adjacent the outer edge 20 of outer rim 18, as shown
22 best in Figures 1 and 4. These louvers 50 permit the entry of
23 cooling air into the drive belt housing 100 as drawn in by the
24 rotating action of the fan blades 14 on motor drive pulley 12. The
25 cooling air thus brought in through louvers 50 acts to cool the
26 drive belt 96 and thus increase the lifespan of the drive belt 96.

27 Positioned on the opposite side of drive belt housing 100 is
28 a metal mesh screen 52 positioned adjacent the inner edge 22 of

1 outer rim **18** of motor drive pulley **12**. The metal mesh screen **52**
2 serves two purposes, the first being to permit transfer of cooling
3 air driven by rotational action of the fan blades **14** on motor drive
4 pulley **12** from the drive belt housing **100** into the vicinity of the
5 engine **90** for cooling thereof, and the second purpose being to
6 screen and prevent potentially harmful solid debris from being
7 directed into the engine **90** via the action of fan blades **14** of
8 motor drive pulley **12**. Of course, it should be noted that various
9 other types of air passage structures may be used with the drive
10 belt housing **100** of the present invention which permit the passage
11 of cooling air to the engine **90** and drive belt **96**, but it has been
12 found that the drive belt housing **100** which includes the louvers **50**
13 and metal mesh screen **52** provides a safe, yet efficient,
14 arrangement of elements which permit the passage of cooling air to
15 the critical elements of the motor-driven pressure washer **80**.

16 It is to be understood that numerous additions, modifications,
17 and substitutions may be made to the improved cooling fan mechanism
18 **10** of the present invention which fall within the intended broad
19 scope of the appended claims. For example, the size, shape, and
20 construction materials used in connection with the improved cooling
21 fan mechanism **10** and motor-driven pressure washer **80** of the present
22 invention may be modified or changed so long as the intended
23 functional features of the invention are maintained. Furthermore,
24 the precise size, shape, number and angle of the fan blades **14** on
25 motor drive pulley **12** may be modified or changed depending on the
26 cooling characteristics desired and speeds at which the motor drive
27 pulley **12** will be rotated, and such modifications to those fan
28 blades specifics may be determined via experimentation and

1 operation. Also, as was stated previously, the precise size,
2 shape, and design of the drive belt housing **100**, louvers **50**, and
3 metal mesh screen **52**, may be modified or changed so long as the
4 intended functional characteristic of permitting passage of cooling
5 air from the outside of the drive belt housing **100** there through
6 and into the engine **90** is maintained or enhanced. The present
7 invention may also include a plurality of rubberized vibration
8 dampers **101** mounted on the drive belt housing **100** should the use of
9 such vibration dampers be desired. Finally, the layout of the
10 features of the motor-driven pressure washer **80** may be modified or
11 changed according to various manufacturers' designs, but it should
12 be noted that the motor drive pulley **12** having at least one fan
13 blade **14** thereon is a critical element of the improved cooling fan
14 mechanism **10** of the present invention and may be adapted or
15 modified for use with many different types of motor-driven pressure
16 washers.

17 There has therefore been shown and described an improved
18 cooling fan mechanism for a motor-driven pressure washer which
19 accomplishes at least all of its intended objectives.